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ABSTRACT

To be effective, project management requires a heavy dependence on the document, list, and computational capability of a computerized environment. Now that microcomputers are readily available, only the rediscovery of classic project management methodology is required for improved resource allocation in small research projects. This paper provides an overview of project management, its associated tools, and the key literature in the field. The term "project" refers to the organization doing the work, dedicated to completing a single task within a specific time frame. The overall project task is differentiated from a routine task by virtue of its: (1) requiring an unusually rapid completion time; (2) meeting very tight cost constraints; and (3) need to dispel considerable initial uncertainty among project personnel regarding completion methods. These three criteria underline the project's finite nature and emphasize the exaggerated concern for maintaining schedules and costs. Accompanied by numerous illustrations, project management concepts such as preplanning, project control, work breakdown structure, graphic management procedures, and project scheduling are thoroughly discussed. Because certain evaluation tools can assume a reality of their own, management intervention may be needed to complete tasks on schedule. The justification for using project management tools may be found in improved grant management. (11 references) (MLH)

BASIC PROJECT MANAGEMENT METHODOLOGIES FOR SURVEY RESEARCHERS

Presented at the 1988 Meeting of NCPEA in Kalamazoo, Michigan

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BASIC PROJECT MANAGEMENT METHODOLOGIES FOR SURVEY RESEARCHERS

INTRODUCTION

With the continuing erosion of the resource base available for research in the social sciences, especially in survey research, the requirement for maximizing the impact of those resources which do exist has been growing. One area where improvements in efficiency have been demonstrated is in the application of several well understood tools and approaches to the management of work. Specifically, the use of project management techniques has yielded cost savings and increases in work efficiency when compared to the utilization of routine management practices. Unfortunately, project management, to be effective, requires a heavy dependence on the document, list, and computational capability of a computerized environment. In the past, the use of this environment has only been cost effective in work efforts above one or two hundred thousand dollars. This computing requirement has generally precluded the effective use of project management approaches in the social sciences and therefore has not been widely discussed in the recent literature. Additionally, several of the tools used in project management, such as the Project Management and Review Technique (PERT), have been applied (and taught) out of context leaving the user with ambivalent feelings regarding the tool's effectiveness. The situation is similar to an individual attempting a large multiple regression, by hand, without the level of knowledge sufficient to understand that it is a multivariate tool. It can be done, but not well, and would be done only once. However, the advent of machines such as the Macintosh II and the IBM 50 has radically changed the underlying problems of using project management methods for research involving grants in the range of ten thousand dollars and above. At the present time, the computer environment is often readily available. Only the rediscovery of classic project management methodology by researchers is required for improved resource allocation in small research projects. This article may provide the reader with an overview of project management, its associated tools, and the

key literature in the field.

The term project management (PM) is applied to a series of approaches to management and its associated tools which, with the exception of a few which originated in the thirties, were developed in the sixties. In this project management methodology, the term project has a unique connotation. Here the project itself is viewed as an organization by which work is accomplished rather than the work or task itself. The scope of this organization can be a graduate student developing a dissertation or a large number of people undertaking a moon landing. Size is not the issue. The organization is the structure by which a task gets done.

The overall project task is itself differentiated from a routine task in that it is viewed as meeting one of several criteria such as (1) a requirement for an unusually rapid completion time and/or (2) very tight cost constraints. Additionally, there is a general sense that (3) the task to be undertaken should be unique in having considerable initial uncertainty among project personnel regarding methods for completion. An experienced professor assigned to teach an introductory research course would not meet any of these criteria. He can manage this teaching assignment quite well without sophisticated management procedures. The graduate student working on a dissertation or a young, inexperienced professor performing on a small federal grant would probably meet all three criteria.

When the foregoing assumption of the project as organization and one of the three criteria are met, they imply a finite nature for the project. That is, the project is an organization dedicated to the completion of a single task. When the task is done, the project is finished; therefore, the project as organization will end at a specific point in time. This is a different characteristic from the non-finite nature of routine organizational existence and creates an exaggerated concern for maintaining schedules and costs. In a project, schedule and cost overruns are difficult to recover from in that, as examples, the graduate student can reach a point in time that exceeds graduate school deadlines for program completion, and the professor may not receive continued funding after the ending date of the grant. In routine tasks, this finite termination point is usually less pronounced if it exists at all. Schedules can be extended and costs can be absorbed by ongoing and routine activities. Also, in the non-project

organization, when a task is complete the organization continues and employees shift to new assignments. When a medium-sized grant ends, some employees may become unemployed. These considerations give rise to a requirement for management practices which differ from those found in most organizations. These practices must be specifically sensitive to working in uncertainty, with time and cost constraints operating in a setting where the organization will terminate. Project management is the term used to broadly define these practices.

PREPLANNING

Project management begins when the organization required for task completion is established. This can come at any one of several points: prior to a Request for Proposal (RFP) or after a grant has been awarded. Several issues will be of concern at the beginning of a project. A project manager will face issues such as:

A. What is the relationship between the project and the parent organization?
   - Organizational and structural relationships
   - Determination of reporting lines and the chain of command
   - Establishment of the project's priority
   - Agreement on overhead recovery by the parent organization
   - Agreement on employee equity principle (People working on a project are not disadvantaged vis-a-vis their position in the parent organization).
   - Staffing the project

B. Does the project manager actually have the capacity to perform as necessary?
   - Control of schedule
   - Control of budget
   - Control of performance criteria

When these issues are resolved, a technical planning theory known as "Bounded Rationality" (Simon and March, 1958; and Faludi, 1973) serves as a

philosophic umbrella under which any one of several planning paradigms can be employed in developing a set of activities and events which will lead to the completion of the project task. This is not necessarily a cognitive process. Managers tend to be rationalists without being aware that alternatives to that philosophy exist. An example of a rational process has been defined by Brieve, Johnston, and Young (1973).

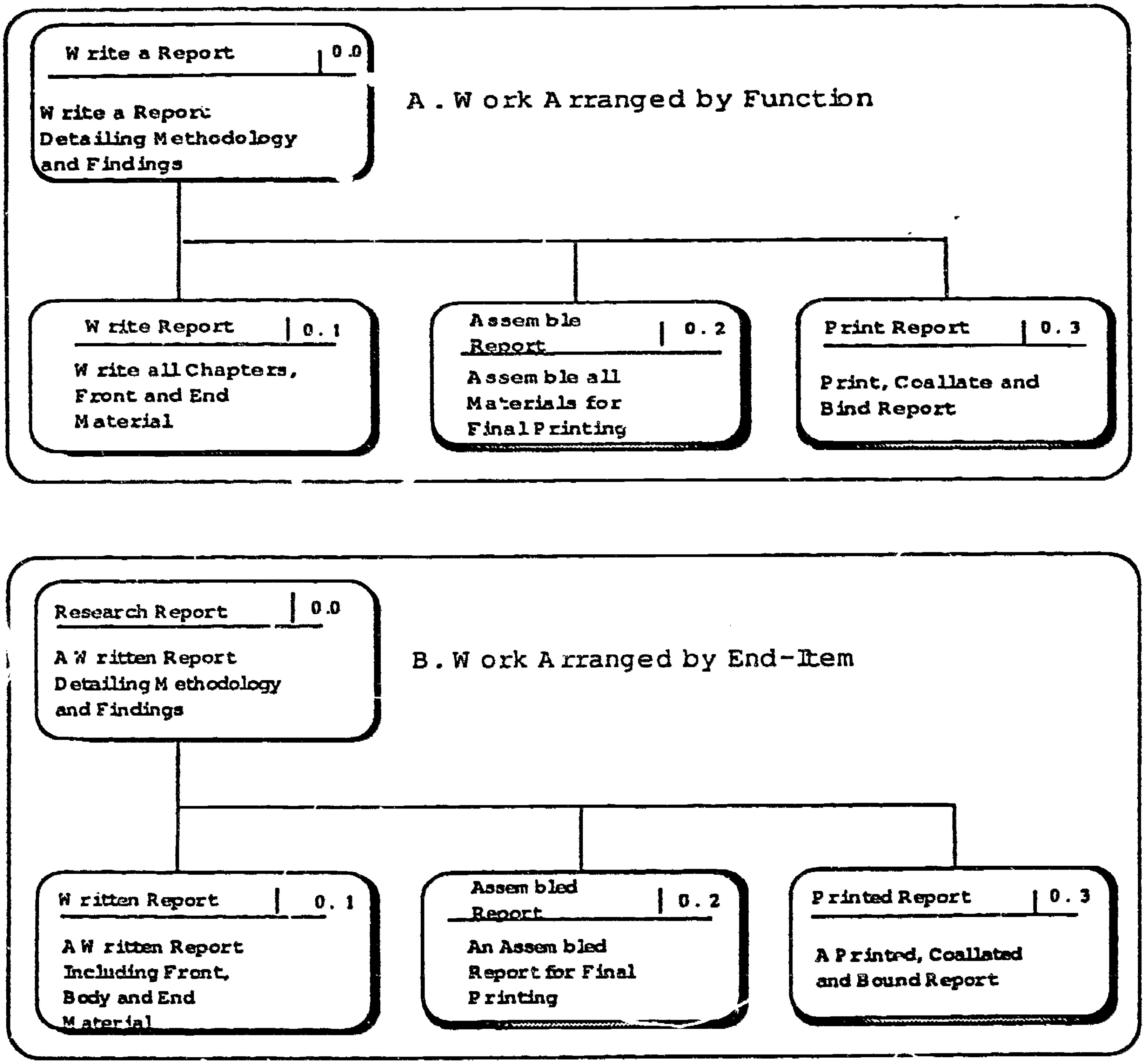
A. Establish Goals
B. Determine Need
C. Determine Restraints and Resources
D. Establish Performance Objectives
E. Determine Alternative Solutions
F. Analyze Alternatives
G. Select Alternatives
H. Establish Objectives
I. Evaluate Performance
J. Modify as Required

Project managers are not exceptional vis-a-vis rational management. Their tools, if anything, are overly rational. The processes which follow are, therefore, highly rational.

When an outline of a strategy for completing the task has been established and selected, a process by which that strategy is fleshed out is undertaken. The process is iterative with missing pieces being added as the necessity for their inclusion becomes apparent, and existing elements are modified as required. The process attempts to function in a manner which looks for the tangible products which must exist before the overall task is complete (see Kaufman, 1972 and 1988). This process avoids an arrangement by function which is usually an arrangement by process and not product. Figure 1 illustrates this difference.

Figure 1:

Two Possible Arrangements for Accomplishing a Task

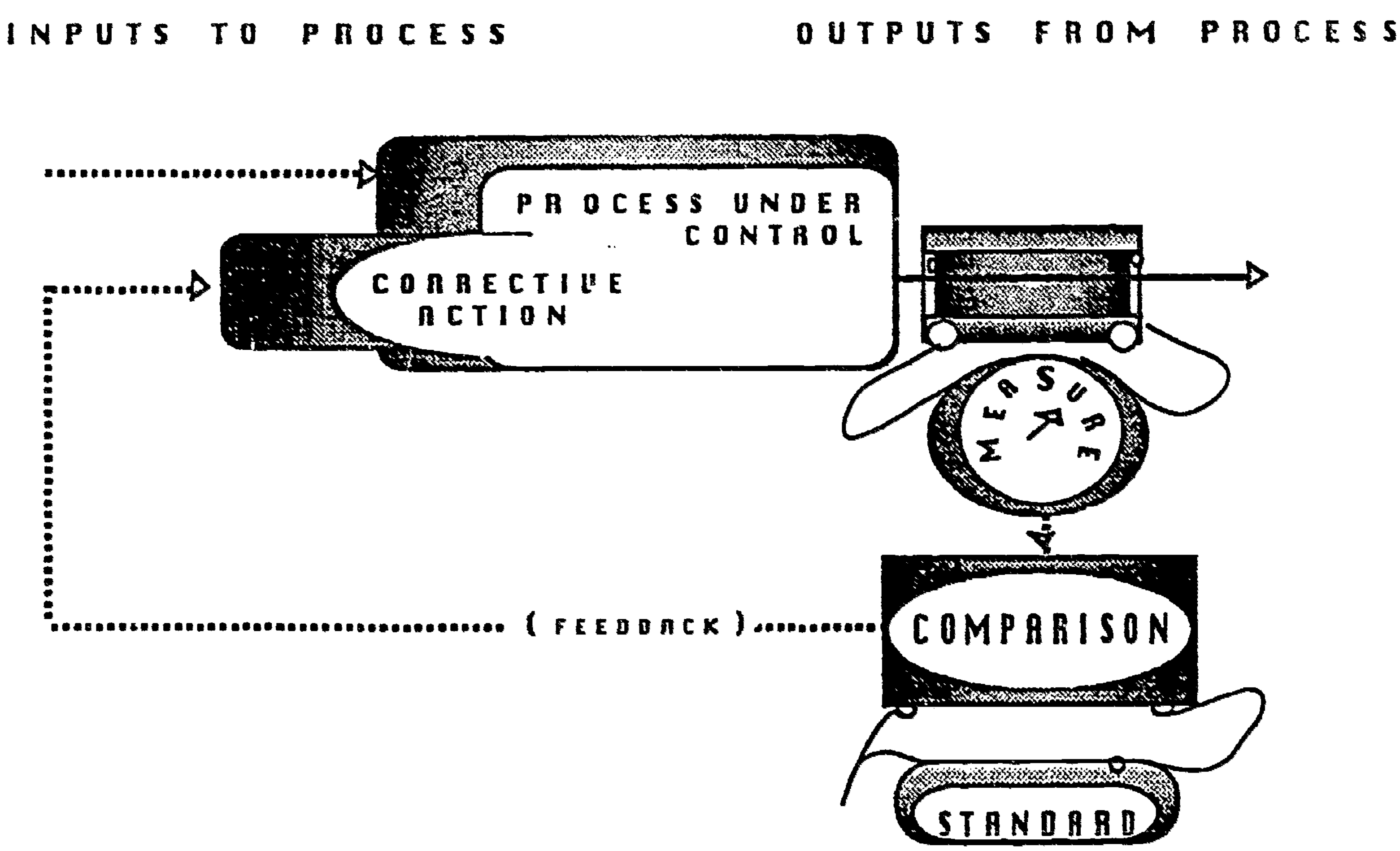


PROJECT CONTROL CONSIDERATIONS

The difference between a functional and a task or end-item arrangement may seem trivial; however, the emphasis placed on developing the end-item orientation provides a considerable improvement in control. Here control has a specific set of requirements: a standard, a measurement, and the ability to take corrective action. These are interrelated requirements which can be modeled as in Figure 2.

Figure 2:

Elements of Control



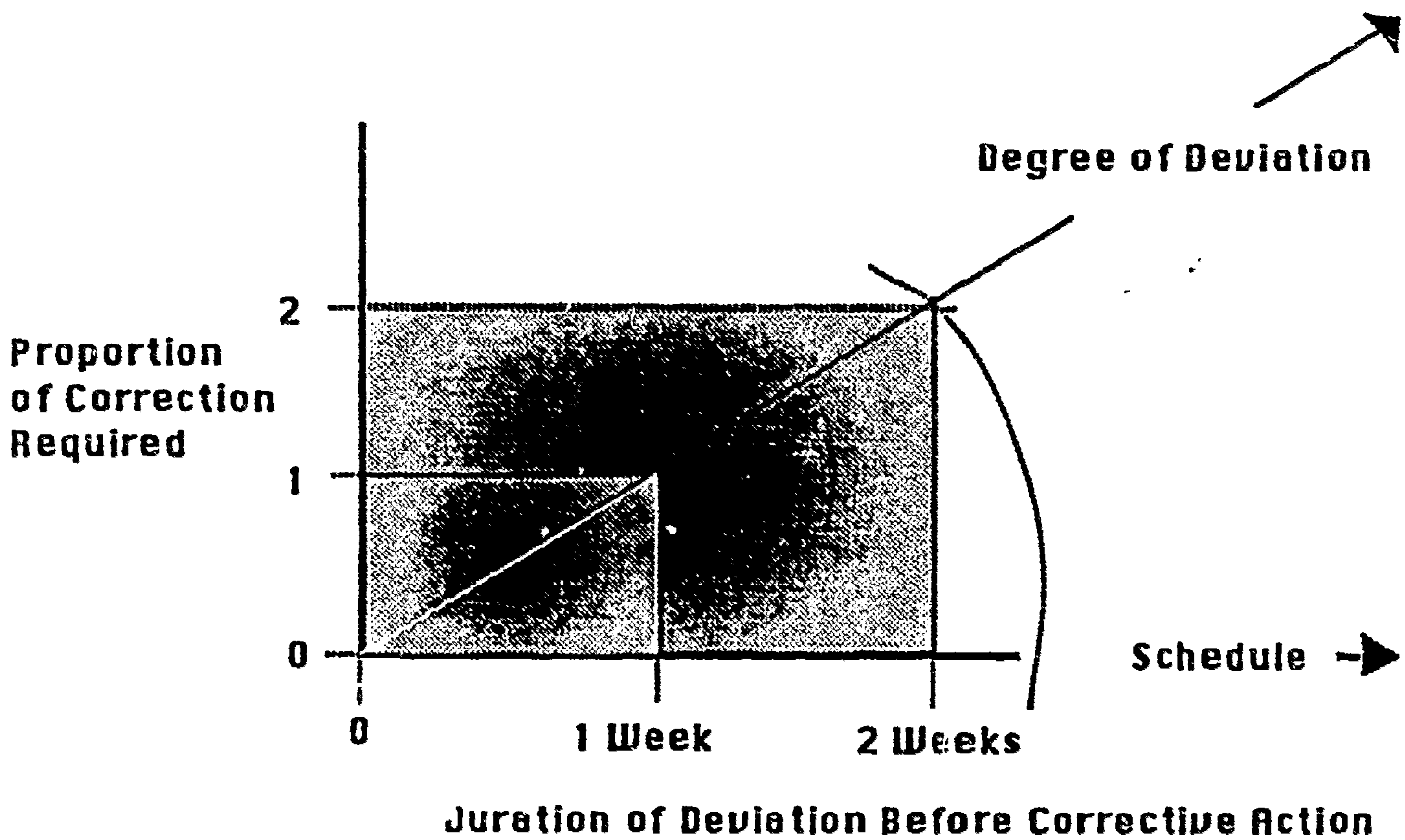
In this illustration the process under control produces a set of outputs. Control attempts to ensure that the outputs produced by the process meet all criteria set for them. This requires a set of standards or criteria which in this context is a plan. The outputs must be measured to determine what is actually being produced. A comparison of the outputs to the standards is then made and a determination is made regarding any differences between outputs and standards. If a deviation exists and it is necessary to bring the output in line with the standard, then corrective action must be taken within the process under control. As an example, consider a survey research project where a student--the process under control--is to complete a written literature review before the end of the week. The standard would obviously be an expectation of the report's delivery by week's end. A measure of output is made in that the report either appears or does not appear. If it appears, then a comparison to the standard demonstrates no deviation. If the report does not appear, then a deviation has occurred. In the latter case, if the report is desired, then corrective action can be taken vis-a-vis the student.

The emphasis in project management is on preplanning and is directed at defining the project's work in terms which increase control, i.e., measurable events: specific deadlines for tangible items as opposed to the activities which produce them. This is critical. Consider, in the student example above, the situation where the directions to the student are to "work on a literature review". The process becomes nebulous in that few measures of output can be made. If asked for the work, a typical reply might be "Well, I have it nearly complete and just a few more days will finish it.". Real control has been lost. A savvy project manager will even create events which are not specifically required by contract but without which control would be reduced. Draft documents and reporting at "In-Process Reviews" are typical of this procedure.

This issue can be further illustrated where, in Figure 3, it can be seen that the action required to correct an ongoing deviation increases directly with time.

Figure 3:

Proportional Actions Required to Correct a Deviation



Preplanning provides additional benefits such as a more clearly thought through effort which reduces boondoggles, but maintaining control is the primary concern. Certainly, at some point consideration must be given to the activities required to produce each end-item. Most Project Managers with experience in large projects will postpone this consideration as long as possible.

The structure illustrated in Figure 1b above is therefore preferable and generally used. From the initial articulation of end-items, the number of items is expanded with the items required for each sub-component being entered into the

organizational structure. For instance, the Written Report (0.1) may require a data set (0.1.1) and a theme/hypothesis (0.1.2) around which the text will center, etc. The format used in organizing this information is not usually that presented in Figure 1 but rather a tabular format such as that used in Figure 4.

Figure 4:

A Requirements List

PROJECT: RESEARCH REPORT

End-Item Required	Item Code
Research Report	0.0
Written Report	0.1
Data set	0.1.1
Questionnaires	0.1.1.1
Returned Questionnaires	0.1.1.2
An Analysis	0.1.1.3
Research Questions	0.1.1.4
Theme-Hypothesis	0.1.2
Assembled Report	0.2
Printed Report	0.3

The process of expanding this list of items continues until project personnel are satisfied that all major requirements are listed and that the level of detail is sufficient to provide an understanding of what must be

done. When this is completed, the end-items are related to each other in temporal sequence. This ordering is not by specific date but is ordinal by sequence--first things before second things, etc.

When complete, the list of sequenced and prioritized end-items is converted to a list detailing the set of activities required to produce each end-item. Each end-item will have at least one activity and probably several associated with it. Each activity will have an end, usually the end-item it is related to or another activity associated with that same end-item. The beginning and ending of these activities are termed events, and many events are related directly to the end-items in that the point in time when the end-item comes into existence is in itself a significant event.

WORK BREAKDOWN STRUCTURE

From the point of a project's inception throughout the first third of its scheduled duration, an iteration process is conducted where, as knowledge of the required work increases, a continuing deeper articulation of activities and events is developed. This includes breaking the work down into greater detail (lower levels) and also the adding of parameters for cost or for unusual requirements such as a specific facility, a unique personnel requirement, or special equipment. This process usually produces a list which has various and contradictory names. Typically, it is known as the Work Breakdown System (WBS) or the Requirements List. A short list is illustrated in Figure 5.

Figure 5:

A Work Breakdown System or Requirements List

PROJECT: RESEARCH REPORT — BASIC REQUIREMENTS AND PARAMETERS LIST

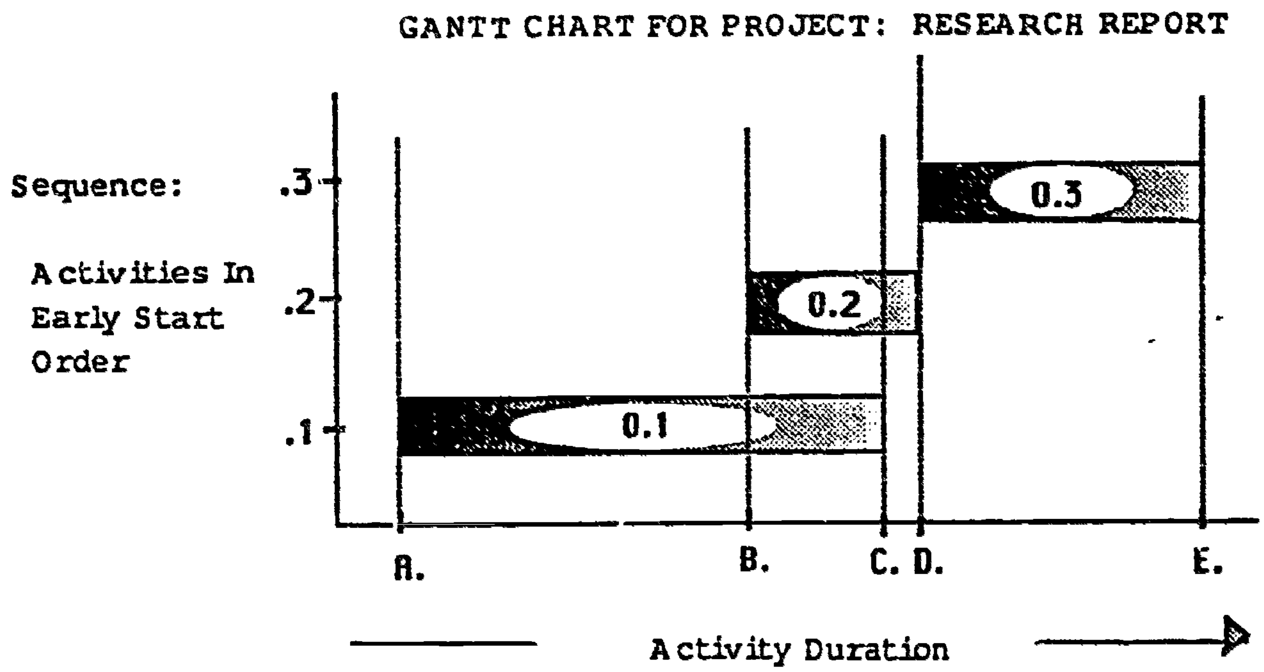
Activity Name:	W #	Scheduled	Times - Weeks a	m	b	Te	Tl	Costs - Dollars Normal	Crash	Responsibility	Special Facilities
Write Report	0.1		18	24	30	24		1,500		Smith, A.K.	
Develop Hyp.	.1.1		1	2	3	2		100	100	Smith, A.K.	
Acquire Data set	.1.2		18	23	30	23.3		1,400		Smith, A.K.	
Dev.Res.Q's	.1.2.1		4	6	8	6		100	100	Wilson, H.	
Develop Qut's	.1.2.2		8	10	18	11		100	100	Wilson, H.	
Receive Qut's	.1.2.3		8	12	20	12.7		1,000	2,000	Wilson, H.	
Analyze Qut's	.1.2.4		4	6	10	6.3		1,200	800	Smith, A.K.	Computer
Assemble Report	0.2		3	4	5	4		100	200	Wilson, H.	
Print Report	0.3	1/6/88	3	7	17	8		2,000	1,000	Rapid Print, Inc.	

GRAPHIC MANAGEMENT PROCEDURES

Most projects have enough events and activities so that a simple listing fails to relate the sequencing and interrelationships between various project tasks. One procedure for improving the ability to relate project components is to present them graphically. A classic method for doing this is through the use of a Gantt chart which sequences sets of activities and extends them over time as illustrated in Figure 6.

Figure 6:

A Project Gantt Chart

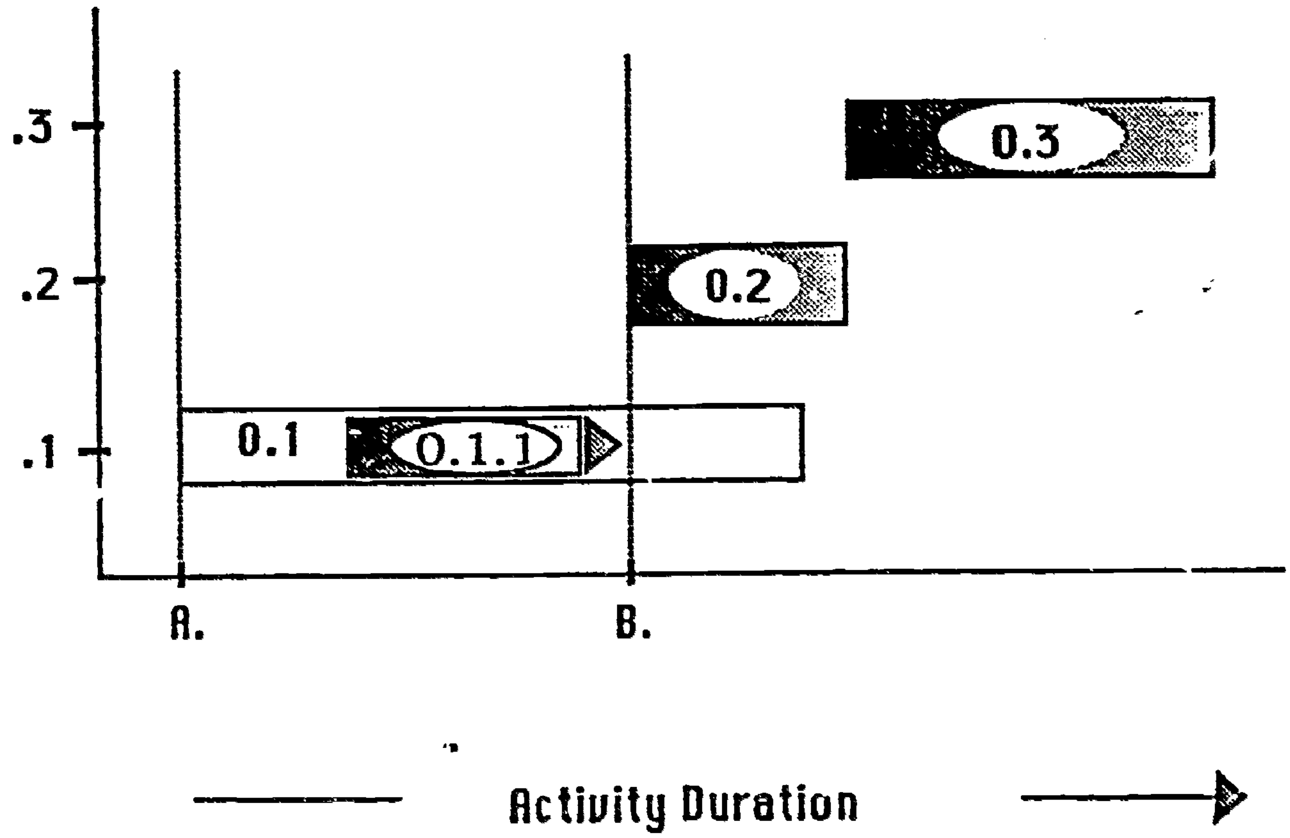


This method of arranging and displaying project information and structure is perhaps the most useful for the small academic research effort. Little prior experience and little time is required to use this format. The Gantt chart can also be easily modified as new tasks are added and as additional levels of work are defined.

However, the Gantt chart has disadvantages which can be serious if large numbers of tasks are being displayed. Note that in Figure 6 the beginning of activity 0.2 which takes place at Activity Duration Point B appears to occur at random, i.e., with no reference to other activities and events. Clearly, some aspect of the plan of work is not being represented in this Gantt chart. Generally, the difficulty lies in the fact that an event in 0.1 "triggers" event B, the start of activity 0.2. This is a dependency relationship where activity 0.2 is said to be dependent on an event in activity 0.1. This is illustrated in Figure 7.

Figure 7:

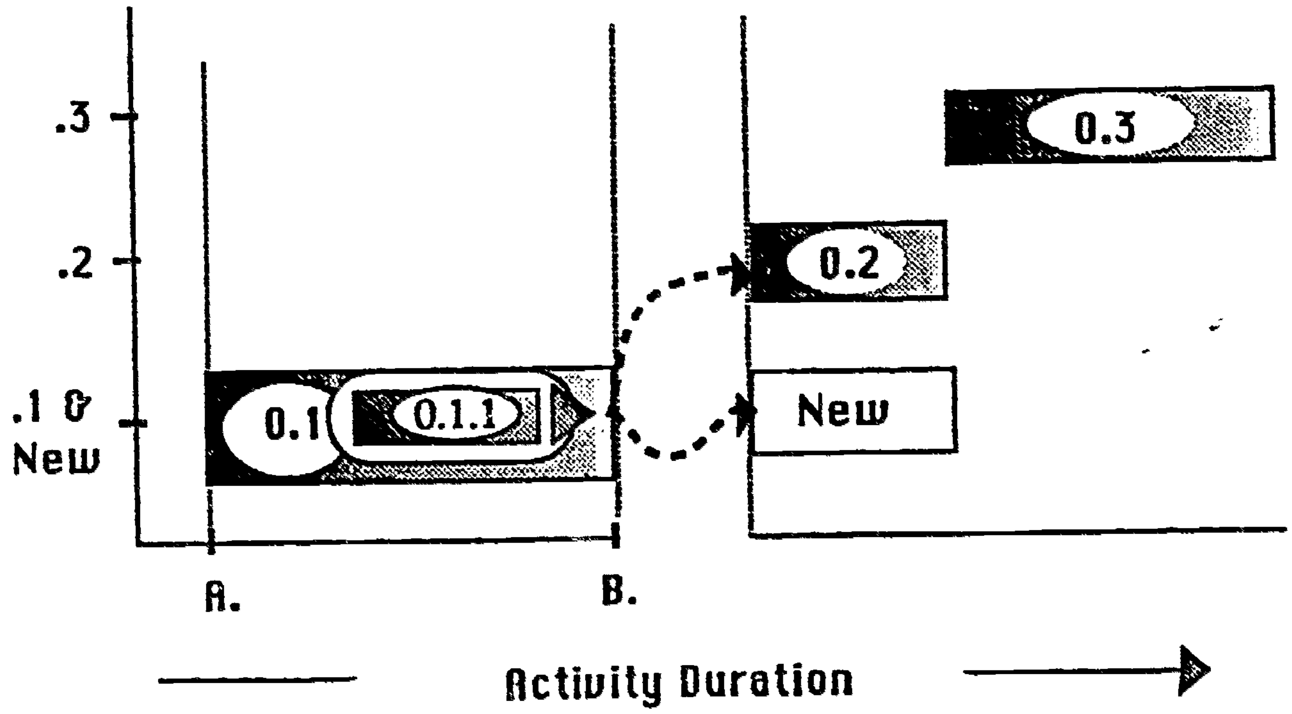
Activity Interdependency Across Work Levels



This dependency of activity 0.2 on activity 0.1.1 can be shown but only at the expense of several of the characteristics that make the Gantt chart an excellent tool. The method used is one which splits activity 0.1 into two activities separated at event B. This creates a new activity in the illustration. It must be remembered that the work to be done remains the same and that the procedure is simply a management convenience. The modified Gantt chart is illustrated in Figure 8.

Figure 8:

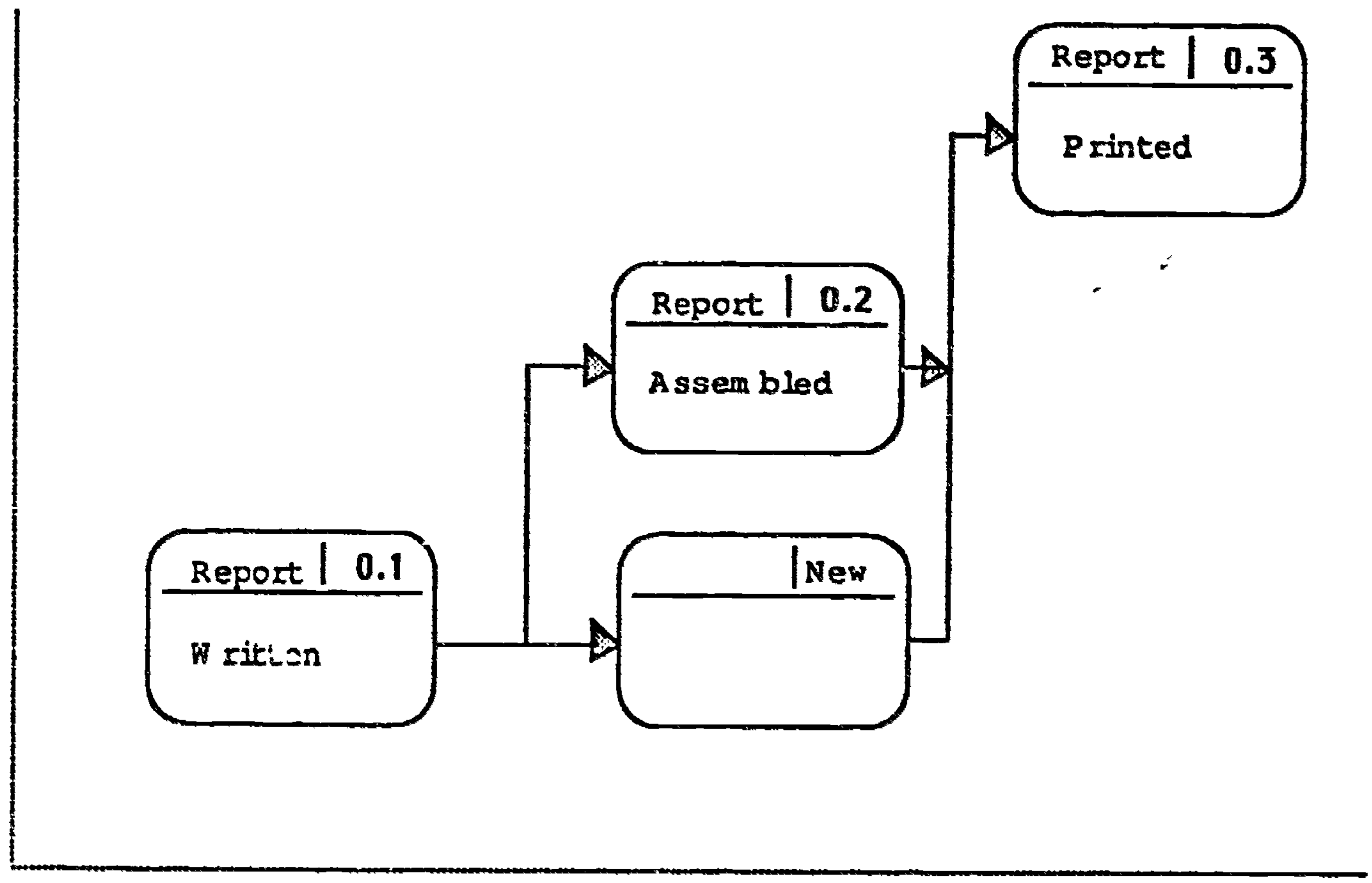
Isolating Activity Dependence



When this division occurs, the Y or vertical axis loses any sequential meaning. Activities can be placed vertically at will. This procedure also removes the meaning of the X or horizontal axis. It is no longer a continuous scale and now must be interpreted as ordinal in nature. This results in a lack of temporal meaning for the rectangle symbol as used to represent the work packages. Any figure--a square, a circle, a letter -will carry the same information as a rectangle. The result of this change--splitting work packages to illustrate dependency relationships--gives rise to a graphic presentation with pieces of work horizontally arranged in temporal sequence and connected by arrows which indicate the dependency relationships. A classic tool based on this format is the flowchart illustrated in Figure 9. An early introduction to flowcharting in education, although heavily oriented toward computing, was made by Banghart (1969).

Figure 9:

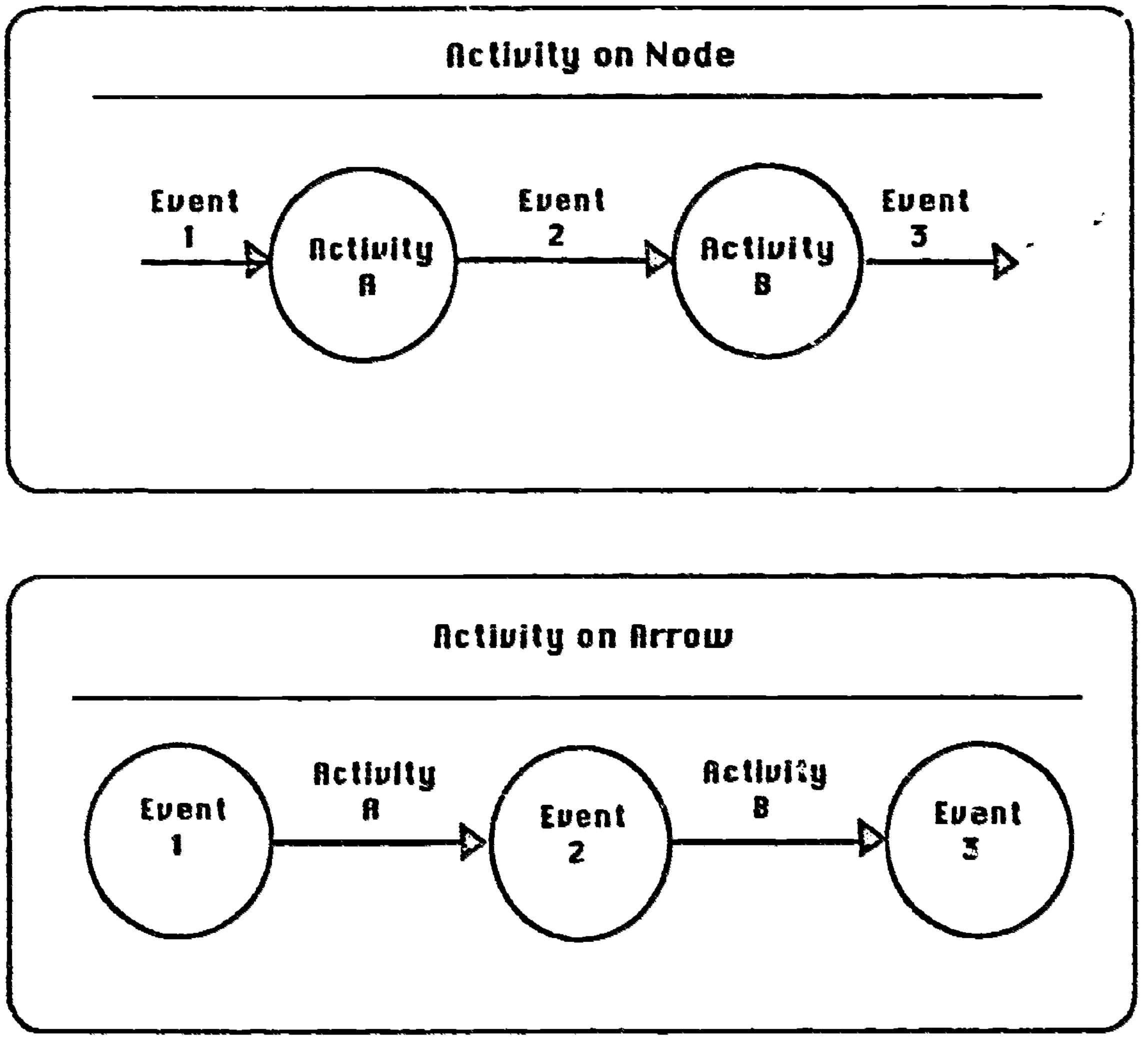
Basic Flowchart



Two methods for illustrating the relationships involved in this type graphic are used. The Flowchart, Figure 9, is an example of a format known as Activity on Node. The alternative is to place the Activities on the Arrows. Unfortunately, they are opposites and tend to confuse students. Figure 10 illustrates both these methods.

Figure 10:

Two Methods of Relating Activities and Events



Both methods are equally effective and each has advantages and advocates. Flow charts and Critical Path Method (CPM) networks use Activity on Node. Program Evaluation and Review Technique (PERT) networks are usually Activity on Arrow.

The discussion which follows will use Activity on Arrow format for two reasons. First, most readers will be unfamiliar with this format and may

prefer to learn a different methodology from the familiar flowchart, and second, PERT, with its Activity-on-Arrow format, involves more complicated calculations than CPM. Therefore, in understanding PERT, one can also work with CPM formats

PROJECT SCHEDULING

In using methodologies beyond Gantt charts, a project manager is most often seeking to deal with the interdependence among activities and events and is attempting to provide a greater capability for scheduling. In general, one can consider the graphic network in a PERT chart as related to the Gantt chart. The definitive text on network tools, specifically PERT, is by Archibald and Villoria (1967). A fairly complete coverage of the topic, including the statistical procedures, can be found in this work. A simple PERT chart is illustrated in Figure 10. Several applications of PERT in education are discussed in Handy and Hussain (1969). Other authors have related PERT and similar network tools to education (Tanner and Williams; 1981; Hentschke, 1975; Banghart, 1969; Cook, 1964).

However, the requirements of PERT are that for each activity three estimates of activity duration be made. These estimations are made under an assumption that a sample of duration estimates for an activity will not necessarily be normally distributed. The distribution used for PERT statistics is assumed to be a Beta distribution. The statistics used in PERT however are heuristic in nature with many statistically unsupportable assumptions being made. The justification for using PERT statistics is that, over time, the computations yield results in good agreement to those observed on most projects. In determining duration times, Equation 1 is used.

Equation 1: Calculating Expected Activity Duration

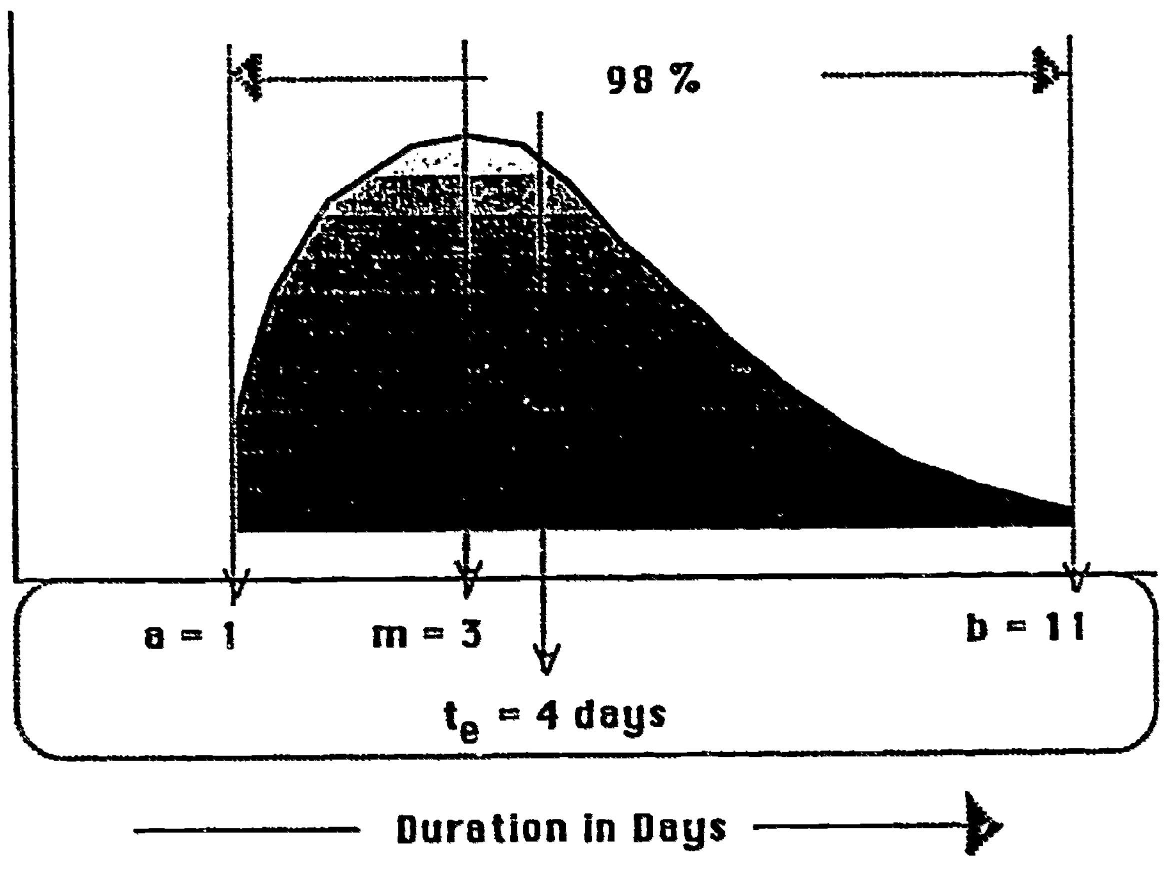
$$t_e = (a + 4m + b)/6$$

t_e = Activity Expected Elapsed Time
a = Optimistic Time
m = Most Likely Time
b = Pessimistic Time

The Optimistic Time (a) is that estimate of activity duration which is optimistically short and would only occur one time in one hundred observations of the activity's behavior under normal conditions. Acts of god and bizarre events are not considered in these estimates. Pessimistic Time (b) is similar but obviously based on the longest time that the activity can take. The Most Likely Time (m) is the time most likely to be observed. For an activity in which a = 1, m = 3, and b = 11, the Activity Expected Elapsed Time (t_e) would be four days. These can be related to a distribution of possible times as in Figure 11.

Figure 11:

Statistical Assumptions and Definitions in PERT



From the a, m, and b time estimates, the activity's standard deviation is calculated as Equation 2 illustrates.

Equation 2: Calculation of Activity Standard Deviation

$s = (b - a)/6$

s = Activity Standard Deviation
a = Optimistic Time
b = Pessimistic Time

In the example where $a = 1$ and $b = 11$, the activity standard deviation would be 1.67 days. Variance is defined as the square of the standard deviation. Both terms are used to compare activities relative to the potential for deviation from the Activity Expected Elapsed Time (t_e). When calculated, these values are entered into the requirements list (Figure 5) as additional activity parameters and are shown in Figure 12.

Figure 12:

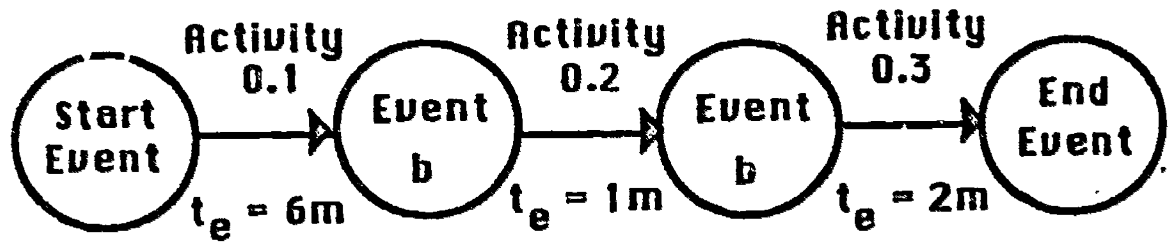
Work Breakdown Structure or Requirements List

PROJECT: RESEARCH REPORT BASIC REQUIREMENTS AND PARAMETERS LIST

Activity Name:	WI #	Scheduled	a	m	b	Te	Tl	Normal	Crash	Responsibility	Special Facilities
			Times - Weeks					Costs - Dollars			
Write Report	0.1		18	24	30	24		1,500		Smith, A.K.	
Develop Hyp.	1.1		1	2	3	2		100	100	Smith, A.K.	
Acquire Data set	1.2		18	23	30	23.3		1,400		Smith, A.K.	
Dev.Res.Q's	1.2.1		4	6	8	6		100	100	Wilson, H.	
Develop Qut's	1.2.2		8	10	18	11		100	100	Wilson, H.	
Receive Qut's	1.2.3		8	12	20	12.7		1,000	2,000	Wilson, H.	
Analyze Qut's	1.2.4		4	6	10	6.3		1,200	800	Smith, A.K.	Computer
Assemble Report	0.2		3	4	5	4		100	200	Wilson, H.	
Print Report	0.3	1/6/88	3	7	17	8		2,000	1,000	Rapid Print, Inc.	

With these parameters, an arrangement of activities is sought which focuses on the interdependency of activities and the expected duration of each activity. The graphic network used is the PERT chart illustrated in Figure 13 where the research report activity times are six, one, and two months respectively for activities 0.1, 0.2, and 0.3.

Figure 13: Simple PERT Chart for the Research Report



A visual scan of this network indicates that the total time that will elapse before the end event occurs is the combination of activity times, nine months. Technically, this is derived by determining the time of occurrence for each event. The symbol (T_E) is the Earliest Expected Event Time. These times are calculated using Equation 3.

Equation 3: Calculation of Network Expected Event Times.

T_E = Largest alternative of:

(t_e of a preceding activity) + (T_E of preceding event)

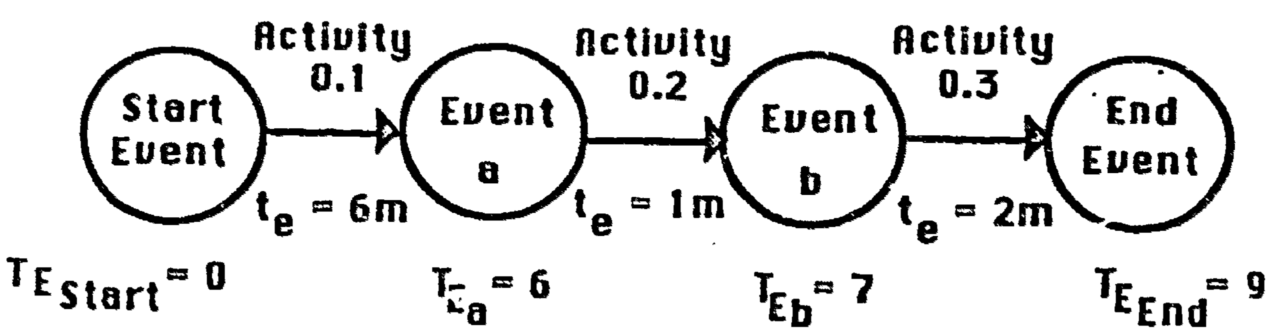
t_e = Expected Activity Duration

T_E = Earliest Expected Event Time

Figure 14 illustrates the network with the event times.

Figure 14:

Simple PERT Chart with Expected Event Times



The interpretation of this network is that activity 0.2 is dependent and cannot be started until activity 0.1 is completed. Likewise, activity 0.3 is dependent on activity 0.2's completion before it can be begun. It can also be determined that the natural elapsed time for this project is expected to be nine months.

The overall standard deviation for this network can also be calculated using Equation 4.

Equation 4. Network Standard Deviation:

$$SD_{Network} = \sqrt[CP]{(t_{e_1})^2 + (t_{e_2})^2 + (t_{\ldots n})^2}$$

SD = Network Standard Deviation

Solving for the network in Figure 14 yields a network standard deviation of 3.1 weeks.

The standard deviation can be used to normalize the Beta distribution and then determine an on-time completion probability from a table of probability. Equation 5 illustrates these calculations.

Equation 5: Calculation of a Network Z Score

$$Z = (T_S - T_E)/S_n \qquad Z = \text{Z Score}$$

With the printed report due on 1/6/88 (M/D/Y), the on-time probability would be calculated as follows, assuming a start date of 1/10/87:

$$Z = (32 \text{ weeks} - 36 \text{ weeks})/\ 3.1 \text{ weeks} = -1.3$$

Referring to a standard normal distribution table it can be observed that:

Z score	Probability
0.0	.50
- .5	.31
-1.0	.16
-1.3	.1

The work, as designed, has only a 10% chance of being completed on schedule.

WORK ANALYSIS

It is at this point that the efforts invested in planning begin to be rewarded. The project manager has a means of examining the way in which the work is to be done and make changes in advance of actual operations. For example, the present network time of nine months is about a twelve percent overrun. Two means exist for reducing the natural or expected time of this work by

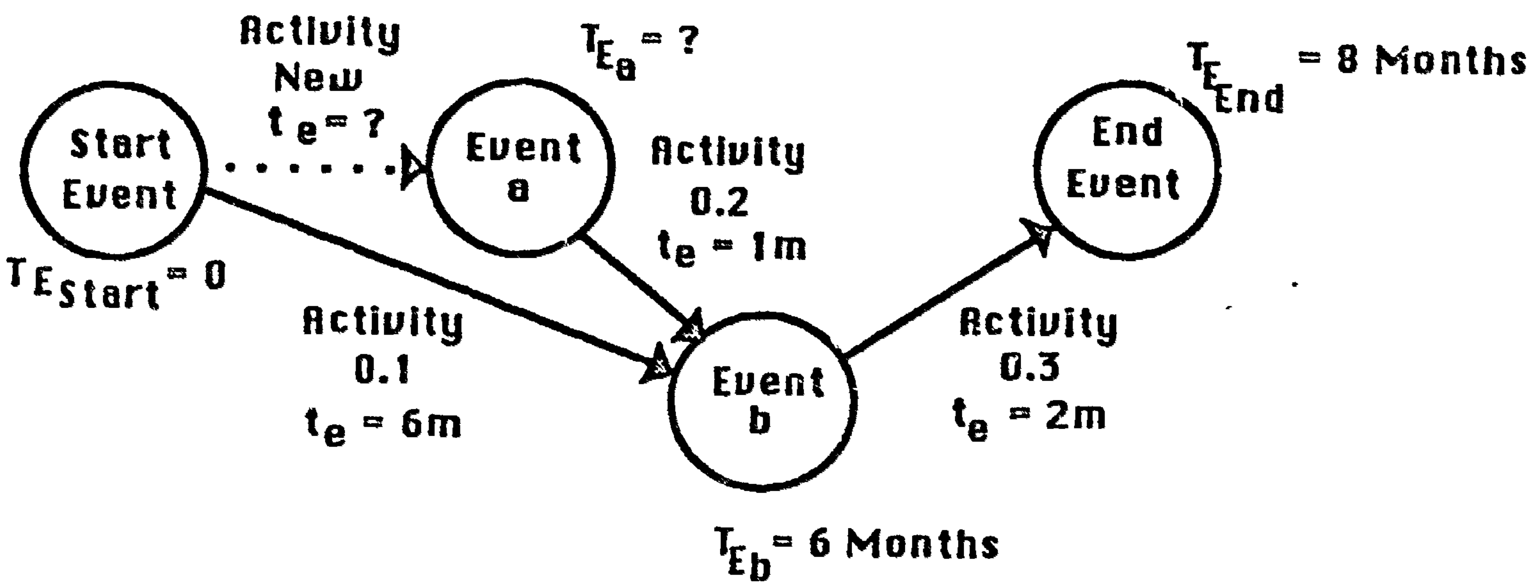
one month. First, the time allowed for each activity can be reduced. This creates a problem in that the probability of a successful outcome is not really changed; only the appearance of an expected time equaling the scheduled time is achieved. If an activity really takes one week, then saying that it takes four days makes no real change. The activity will take a week, regardless. Shortening activities only works when additional resources are used. The costs associated with shortening an activity are known as "crash costs", usually stated as dollars per day of shortening. Figure 12 has the cost of crashing activities indicated. Some guidelines exist for crashing activities, but common sense is the best approach. First, one cannot reduce an activity by one day if the activity only takes one day. The time must be there to begin with. Second, by observing the standard deviation of the activity, an estimate of the ease of reducing the activity can be made.

The second method to use in shortening a network can be seen by noting that the activities in the network are all sequential which is also known as a series structure. It may be possible to remove the dependency relationships which have been imposed on the work by isolating the cause of the dependency and removing it. This may involve additional resources such as hiring more workers, renting additional facilities, etc., or may involve looking at a lower level in the work breakdown structure and finding points where overlapping can occur. The project manager seeks to make activities parallel to the main flow of work.

In the example that has been used, the level being illustrated has been the 0.0 level. By observing the activities in the .0.0 level, it becomes clear that some report assembly (0.2) could take place during the actual writing activity (0.1). This could be done by preparing appendices, blank tables, etc., prior to data analysis. This implies that the network in Figure 15 is possible.

Figure 15:

A Re-structured, Parallel, Simple PERT Network



This network is interpreted as meaning that event b is the conclusion of activity 0.1 and activity 0.2, both of which are done in parallel. Activity 0.2 must, however, be delayed and this is done by introducing a "New Activity", a dummy, shown by the dotted line, which indicates that no effort is required for its completion. The events are associated with different activities (event a is now the beginning of activity 0.2 for example) which is somewhat confusing, but overall the network is shortened by one month.

It should be noted that when the project's work is performed with activities in parallel, a situation arises where at least two "paths" through the network will exist. In the example these are: Start - a - b - End (which requires a total of 3 months), and Start - b - End (which requires a total of 8 months). The latter, in being longer and requiring eight months, is said to be critical. This means that any time deviation in any activity on this path will effect the completion date for the entire network. This is not the case for the shorter path unless the deviation is very large. It is said to have "slack" or "float".

By determining the critical path for the network, the project manager learns two important characteristics about the arrangement of work being proposed. First, the activities on the critical path must be closely observed and have deviations corrected rapidly if the overall effort is to remain on schedule. This is not as important for activities not on the critical path. Second, non-critical activities may have resources, principally people, that can be shifted to critical path activities. This slows down the non-critical activity but this is acceptable especially if a shortening of the critical path is gained. The procedures involved in calculating slack can be refined with the Latest Allowable Time (T_L) for events being determined and compared to Earliest Expected Event Time (T_E) for that event which yields the value for slack at that point in the network. An understanding of these procedures is not required to understand the basic management concepts involved in project management. It is, in fact, at about this point that the student begins to lose sight of the purpose in undertaking the use of project management methodologies--management.

CONCLUSION

It is possible, especially for the inexperienced research manager, for the PERT or CPM calculations to take on a reality of their own. The tool can become an end in itself, a sole reason for using project management in the first place. This is unfortunate, historically, and has created a feeling for many educators that the effort needed to use project management procedures was not warranted in view of the large number of calculations and the heuristic nature of the statistics themselves. Certainly, research grants exist for which this is true. However, whether a project has a 10 percent or a 20 percent chance of being completed on time is not really relevant. The issue is that the individual responsible for completing a grant's activity knows that the probability of on-time completion is not good and that management intervention may be required to complete the tasks on schedule.

The justification for the use of project management tools in research is to be found in improved management. Grants can now be managed at reasonable

cost where, historically, appropriate management procedures were unavailable. That there are technical issues and skills involved in an activity is nothing new for the researcher, and project management is no exception. If a procedure is appropriate and cost effective, it is the procedure to use.

References

Archibald, R. & Villoria, R. L. (1967). *Network Based Management Systems (PERT/CPM),* John Wiley and Sons, Inc., New York.

Banghart, F. (1969). *Educational Systems Analysis,* Macmillan Company, London.

Brieve, F., Johnston, A., & Young, K. (1973). *Educational Planning,* Charles A. Jones Publishing, Worthington.

Cook, D. (1964). *An Introduction to PERT. Occasional Paper 64-156.*, The Bureau of Educational Research and Service. The Ohio State University., Columbus

Faludi, A. (Ed.). (1973). *A Reader in Planning Theory,* Pergamon Press, Oxford.

Handy, H., & Hussain, K. (1969). *Network Analysis for Educational Management,* Prentice - Hall Inc., Englewood.

Hentschke, G. (1975). *Management Operations in Education,* McCutchan Publishing Corporation, Berkeley.

Kaufman, R. (1972). *Educational System Planning,* Prentice-Hall, Englewood.

Kaufman, R. (1988). *Planning Educational Systems: A Results Based Approach,* Technomic Publishing, Inc., Lancaster.

March, J., & Simon, H. (1959). *Organization,* John Wiley & Sons, New York.

Tanner, C., & Williams, E. (1981). *Educational Planning and Decision Making: A View Through the Organizational Process,* Lexington Books, Lexington.